

Cryomodule Assembly Facility (CAF)

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Goals for SRF Infrastructure



- **To perfect U.S. fabrication & processing of SRF cavities and modules and to demonstrate performance with a full range of testing (including beam)**
 - Deploy ILC design / processing / assembly techniques
 - Establish process controls to reliably achieve high gradient cavity operation and module performance
 - Test cavities and modules at the component level and in a systems test to demonstrate yield, reproducibility and beam performance
- **To facilitate commercial production of SRF components and modules**
 - Train and transfer SRF technology to the US industry
 - Allow industrial participation and input to the process
- **To participate in SRF Research and Development**
 - Develop expertise in SRF technology and provide training base for construction and operation of future accelerators
 - Our attempt to fit into the world's SRF community

All of this work will be carried out with US/international collaboration

Development of Industry



Cryomodule Process	Starts with		Transitions to
Cavity Fabrication	Lab/Industry Collaboration	→	Industry
↓			
Cavity Processing	Lab/Industry Collaboration	→	Industry
↓			
Low Power Test (VTS)	Laboratory	→	Laboratory
↓			
Cavity Dressing	Lab/Industry Collaboration	→	Industry
↓			
High Power Test (HTS)	Laboratory	→	Laboratory
↓			
Cryomodule Fabrication	Lab/Industry Collaboration	→	Industry
↓			
Cryomodule Test (CTS)	Laboratory	→	Laboratory

The technology for cavity fabrication & processing, cavity dressing and cryomodule fabrication will be transferred to Industry.

Cryogenic testing of cavities and cryomodules along with beam tests will remain the responsibility of US laboratories.

Introduction

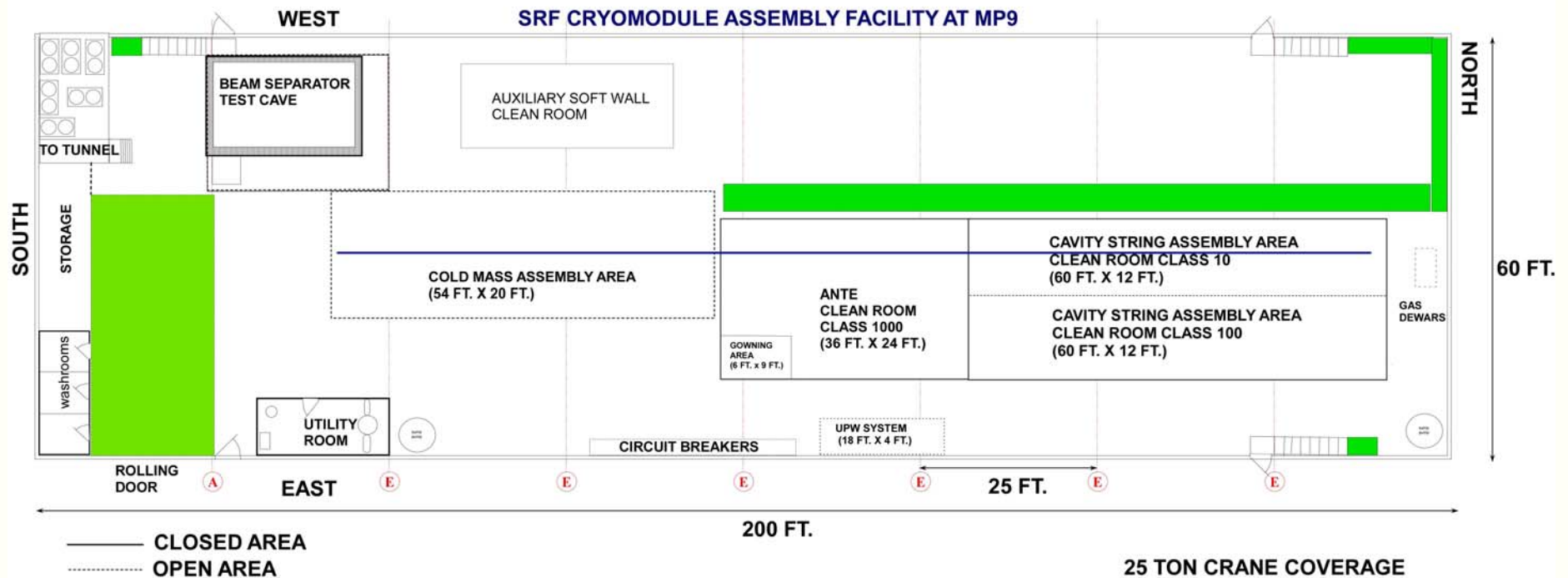


- CAF is an upgraded version of the infrastructure in DESY Hall 3 for cryomodule assembly:
 - Cavity String Assembly
 - Cold Mass Assembly
 - Vacuum Vessel Assembly
 - Final Assembly
- The plan is to assemble this facility in MP-9 building and the Industrial Center Building (ICB) in the Technical Division at FNAL.
- Cryomodule Assembly Facility (CAF) at Fermilab consists of 2 buildings: CAF-MP9 and CAF-ICB.
- The ultimate throughput of this infrastructure will be to assemble 1 cryomodule per month. (12 cryomodules per year).

CAF-MP9



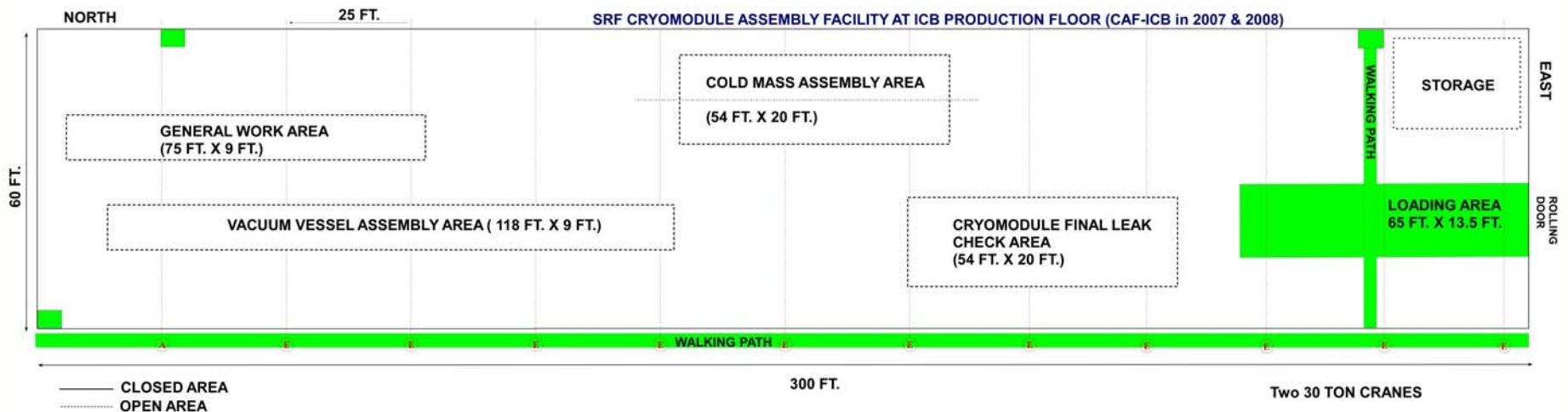
CAF-MP9 houses the string assembly clean rooms, the rail for string assembly under the clean room extending to the cold mass assembly area and the cold mass assembly fixture adjacent to the clean room.



CAF-ICB



CAF-ICB houses the Vacuum Vessel Assembly area and Final Assembly area including the Big Bertha Fixture.



Assembly Workflow @ CAF-MP9

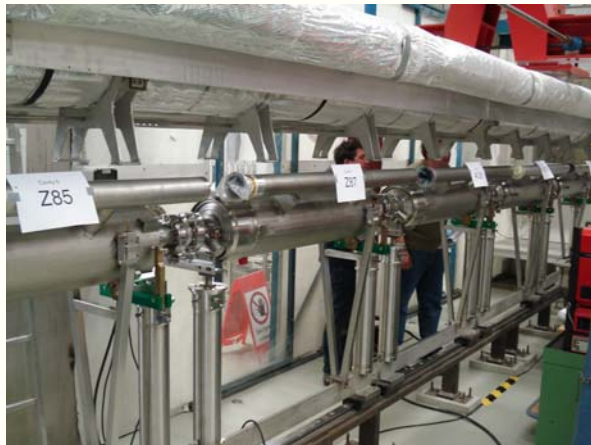


Receive dressed
Cavities

Receive peripheral parts



Assemble
dressed Cavities
to form a String in
the **Cavity String
Assembly Area**
(Clean Room)

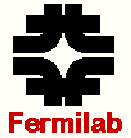


Install String Assembly to
Cold Mass in the **Cold
Mass Assembly Area**



Transport the Cold
Mass to **CAF-ICB**

Assembly Workflow @ CAF-ICB



Install the Cold Mass back to the Cold Mass Assembly Fixture in **Cold Mass Assembly Area**



Align Cavity String to the Cold Mass Support



Install the String assembly with the cold mass into the Vacuum vessel in the **Vacuum Vessel Assembly area**



Ship Completed Cryomodule to **NML** for testing



CAF-MP9 Infrastructure

- Cavity String Assembly Clean Room
- A large clean room was specified and procured in FY05 and installed in FY06 at Fermilab for about \$ 1 M.
- The cavity string assembly clean rooms infrastructure consists of:
 - Class 1000 ante clean room for preparation of the dressed cavities for transportation into the assembly clean room.
 - Class 100 parts and assembly preparation
 - Class 10 assembly clean room where the cavities vacuum is vented to interconnect them with bellows.



CAF-MP9 Infrastructure (cont.)

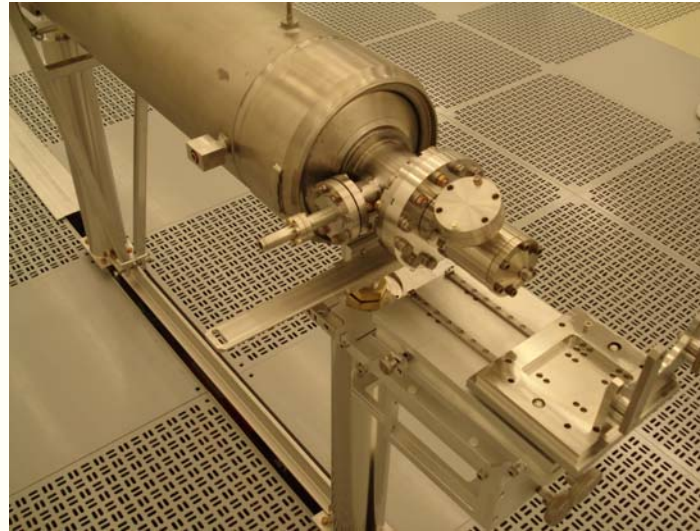
Other infrastructure:

- String Assembly Fixtures
- Vacuum / Ultra Pure Gas Flow Equipment/ Hardware
- Ultrasonic Cleaner
- Ultra pure DI water
- Cavity Handling Cart / Fixture
- Cold Mass Assembly Fixture

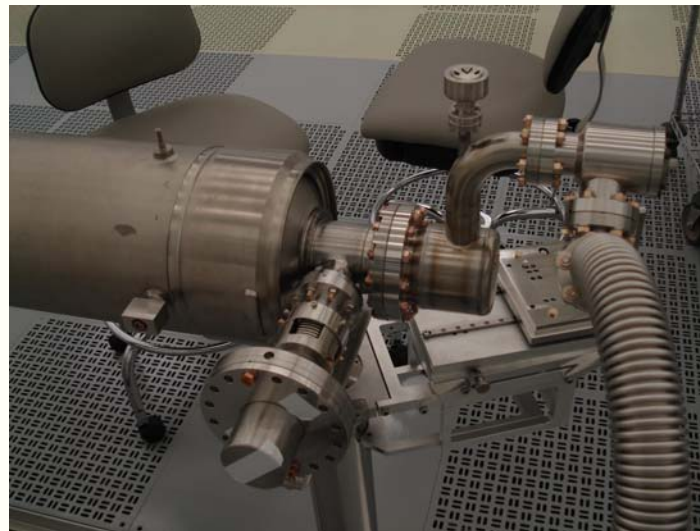


CAF-MP9 Current Status

- Cryomodule Assembly Facility (CAF) in MP9 is now mostly complete.
- CAF-MP9 will continue to be the main CAF building for the assembly of the ILC cavity strings in the clean room in the coming fiscal years.



C22 is being used to commission the Horizontal Test Stand in MDB



C22 is high pressure rinsed and vertical tested in JLab

C22 is prepared for HTS in CAF-MP9 clean room

CAF-ICB Infrastructure



- After the cavity string is picked up off the rail and partially assembled to the cold mass support, the cold mass assembly is transported to the Vacuum Vessel Assembly Area at CAF-ICB.
- Transport fixture will be required to move the cavity string from MP-9 to ICB. (under design review)
- Transport fixture will be required to move the completed cryomodule from CAF-ICB to NML.
- The major CM assembly fixture used in this assembly area is "Big Bertha"
 - a cantilever fixture used to support the cold mass for the remainder of the insulation and power coupler assembly and then slide the vacuum vessel on the assembled cold mass. (One was ordered in FY06 and a second is planned for FY08)
- Portable clean rooms for coupler assembly and specialized vacuum and leak detection equipment
- Various minor fixtures and tooling are necessary during the cold mass, vacuum vessel and final assembly.

CAF-ICB Current Status

- ICB building preparation is completed for CAF-ICB infrastructure installation.
 - Epoxy coat the floor
 - Clean the building
 - Paint the walls
- We will start to install the cold mass and vacuum vessel assembly fixtures by the third week of May 2007.



Conclusions



- CAF Infrastructure setup is progressing as planned. Major tooling / fixtures were designed, procured and installed.
- Tooling shake down and assembly procedures practice (learning curve) are under progress with the mockup cavities sent by DESY.
- Cryomodule Assembly plans in FY07:
 - **1st FNAL ILC Cryomodule Assembly:**
 - Assembly (~4 months): Start date depends when we receive the kit from DESY (July – October 2007) DESY colleagues will assist during the assembly at FNAL.
 - **3.9 GHz DESY TTF Cryomodule Assembly:**
 - Mock-up assemblies (March – May 2007)
 - String Assembly at CAF-MP9
 - Cold Mass & Vacuum Vessel Assembly at CAF-ICB & at DESY